Appendix 4

TELEPHONE PENETRATION: A VIEW OF THE HAVE NOTS

COLORADO PUBLIC UTILITIES COMMISSION

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TELEPHONE PENETRATION: A VIEW OF THE HAVE-NOTS

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Since 1934, the national policy in this country has been a telephone in every house. This goal largely has been achieved for middle and upper income households but not for low income households. According to Belinfante (1989), 92.9% of all U.S. households have a phone compared to only 75.4% of households below the poverty line. Previous research primarily concentrated on telephone penetration for all income groups. This paper concentrates on low income households, for whom it is most important to identify barriers to acquiring a telephone.

The methods used are similar to previous studies and many of the results corroborate earlier investigations. Telephone penetration for low income groups were positively correlated with income, age, number in household, education and home ownership. Issues not examined in other studies but this study found to be barriers to telephone service for low income households included the number of times moved in the past 18 months and deposit fees. The study also examined perceptions of monthly prices, installation cost, deposit fees for low income households with and without a telephone. Perceptions were compared to ability to pay. The gap between perceived cost and ability to pay were greater for households without a telephone than for households with a telephone.

I. INTRODUCTION

The concept of universal service has been central to telecommunications policy since the passage of the Telecommunications Act of 1934. Today, 92.9 percent of all households in the United States have a telephone (See Belinfante, 1989).[1] The 7.1 percent of households without a telephone are not evenly distributed among income groups, but tend to be concentrated in low-income households. Universal service has been achieved for middle and upper income households. It is elusive for low income households.

A. Telecommunications Industry Changes.

Recent changes in the telecommunications industry have raised concern about universal service in general and low income telephone penetration rates in particular. The primary intent of this paper is not to discuss these changes but to address their impact on the poorer segments of society. However, a brief discussion of the major telecommunications events during the 1980's may be helpful. For a detailed discussion of the major events in telephone, see Bolter, et al (1984), Chessler (1989), FCC (1987b), and FCC (1987c).

The major phenomena are the 1984 court ordered divestiture of AT&T and the continued pro-competitive policies of the Federal Communications Commission (FCC). These two primary events spawned several collateral activities: the substitution of a system of access charges for separations and division of revenues; the institution of subscriber line charges; the

simplification of separations procedures; changes in depreciation schedules; and for many jurisdictions, the reduction of subscriber plant factors to 25 percent.

Most of these changes shift costs from the federal to the state jurisdiction, resulting in steady upward pressure on basic exchange rates and a steady downward movement of interstate toll rates [FCC (1988)]. The upward pressure occurred even after the Tax Reform Act of 1984 which was favorable to local exchange companies (see National Regulatory Research Institute, 1987).

Institutional concern about the effect of FCC activities due to divestiture and the agency's pro-competitive policy is expressed in its Monitoring Reports. In 1984, the FCC instituted a $3.50 per month subscriber line charge (SLC) for residential consumers which was to be phased in over a period of several years. The SLC shifted costs, and as a consequence, revenue recovery, from the interstate to the state jurisdiction. The $3.50 charge is added to residential basic exchange rates. The FCC, state regulators, and others were concerned about the effects of such an increase. Consequently, the FCC opened a docket to monitor the effects of SLC implementation. The monitoring report is primarily concerned with Subscribership and Penetration, as well as Lifeline Programs. The Lifeline Program matches the value of state or company assistance up to the amount of the SLC for eligible households. Both the subscribership and penetration and the

lifeline sections of the Monitoring Reports [FCC, 1987b] indicate a concern for telephone penetration for low income household and the stubbornness of low penetration rates for this group.

B. Previous Research

Numerous studies by Taylor (1980), Perl (1978), Perl (1983) and others show the strong relationship between telephone penetration and income. Only a handful of studies have attempted to measure price or income elasticity for installation charges. Black, et al, (1976), Perl (1978) and Belinfante (1988) found significant price elasticity for installation charges.

Virtually all efforts at modeling telephone demand or penetration include price and household income. Most also include variables for age, number of people in household, race, rural/urban location, and education. Many also include variables for the presence of children, children's ages, male/female head of household, employment status, primary language, English proficiency, local calling options, population density, and marital status. The results have been relatively uniform and generally follow Perl's early work.

Perl (1978) concluded that basic telephone service is positively related to income, age and education. It is inversely related to price, and number of persons per household. Perl determined that the probability of a telephone in the household is higher for an employed than unemployed head of household, for urban compared to rural households, and for

white heads of household. Telephone penetration is lower in the south than other regions, and lower for individuals and male heads of household with no spouse than other groups.

Most economic and demographic information used in the various studies is derived from census or census tract data. While each study includes income, none focus exclusively on low income households.

In its Monitoring docket, the FCC ordered certain telephone holding companies to prepare disconnect studies. The purpose of these studies was to determine the reasons households were disconnected from the telephone network. The FCC (1989) results indicate that economic reasons were the primary source of disconnect, and the vast majority of disconnects were low income households.

Each study surveyed by the authors indicates that universal service is an accomplished fact for middle and upper income households. Most of the studies include a disaggregation of income among households. None of the studies surveyed, except the Resource Planning and Management (1988), conducted for Connecticut focus exclusively on low income households. None of the studies compare economic, demographic and social factors of low income households with and without a telephone. None examine the role of perceptions in telephone availability. This study examines each of these issues; in addition, the role of deposit fees and installation charges are more closely examined.

If gains are to be made in aggregate telephone penetration, they will occur among low income households, where penetration rates are relatively low. Moreover, in the so-called information age where communications play a dominant role, the risk of information haves and have-nots is present. Since, the basic line of communication is a telephone, low income households without a telephone risk being automatically excluded from the information age. The economic and demographic characteristics of households without telephones and the reasons they do not have a telephone are necessary for informed telecommunications policy.

II. THE MODEL

A logit model is used to investigate the factors which influence low income Colorado residents decision concerning phone service. The general model is expressed as:

$$\text{Log}\left[(\text{prob})/(1-\text{prob})\right] = f(\text{ea}, \text{hcomp}, \text{hhead}, \text{hten}, \text{ppap}) \quad \text{Eq. 1}$$

Where:

- Prob = the probability of any individual household having a phone
- ea = variables reflecting economic activity
- hcomp = variables reflecting household composition
- hhead = variables reflecting head of household characteristics
- hten = variables reflecting household tenure
- ppap = variables reflecting perceived prices/ability to pay

A logit model of this general nature commonly has been used to investigate the economic and demographic factors influencing telephone availability in a household. In his seminal work on the subject, Perl (1978) discusses the advantages of logit models for this purpose.

The specific variables used for our estimation, with some exceptions, are those commonly used by other researchers. The economic activity variables include household gross cash income and the employment status of the head of household. The household composition variables include number of people in the household, presence of a member in the household over age 65, and households consisting of someone not currently married (separated, divorced, widowed, or never married). The head of household characteristics include: American Indian, Hispanic, or Asian heritage,[2] as well as less than high school education. The household tenure variables include home ownership and a dummy variable indicating whether the household moved in the past 18 months. The final class of variables include the respondents' perceived cost of telephone service and their estimated ability to pay. Perceived prices and ability to pay include the perceptions of the household in the sample regarding the charges for deposit, installation charge and monthly service cost, as well as their estimated ability to pay for each.

The actual price of telephone service was not included in our models. The literature indicates that price generally is

included as an independent variable in this type of analysis. Moreover, demand theory usually requires the inclusion of price as well as the prices of closely related substitutes. Price was excluded due to lack of variation in local telephone prices across customers included in the sample.[3]

III DATA

The data used to estimate the model were obtained with the assistance of the Colorado Department of Social Services (DSS) and U S WEST Communications. A sample of 649 low income households receiving assistance from the Department of Social Services were surveyed concerning a variety of socioeconomic characteristics. The survey was taken by DSS representatives while verifying the accuracy of claims for assistance sponsored by the agency. The interviews were face to face, voluntary and confidential. The survey was conducted between May 15, 1987 and December 15, 1987.

The responses were analyzed for completeness and consistency, and initially 22 responses were deemed not usable. This results in a sample size for the "full" data set of 627 respondents. A second data set was developed to examine perceived price and ability to pay. This necessitated the elimination of samples not responding to the perceived price and ability to pay questions. Sample size for the second data set is 466.

The goal of the survey was not to determine an overall telephone penetration rate for low-income residents, but to determine those characteristics which influence their telephone acquisition decision.

IV. MODEL ESTIMATES

Three specifications were used (Appendix A provides a definition of the variables used with each model). Model 1 is shown in Table 1. The independent variables are income, home ownership, Hispanic head of household, Indian head of household, Asian head of household, number of household members over age 65, head of household with less than a high school diploma, not married, number of people in household. In addition to the type of variable, the table shows the mean value for that variable in the sample, the coefficient and t-statistics for the variable. Independent variables are classified as continuous or dummy variables. All dummy variables begin with a "D" and are designated as indicator variables under the column UNIT. Model 1 uses the full data set with 627 observations.

Model 1 (as well as Models 2 and 3) is estimated by maximum likelihood techniques using the Regression Analysis Times Series (RATS) software package. The goodness of fit of each model is expressed by the number of cases correct. This is defined as the number of observations for which the model estimates that the probability of the household having a phone is greater than (less than) .5 and the household in fact has (does not have) a phone. Model 1 yields 438 correct cases, representing 69.9% of the sample.

Models 2 and 3, shown in Tables 2 and 3 respectively use the smaller data set. They differ from Model 1 in that Model 2 includes a variable for perceived deposit payment and Model 3

includes variables for the gap between the perceived deposit amount and ability to pay and perceived monthly service cost and ability to pay. Also, Models 2 and 3 use an employment variable instead of income to represent economic activity.

Disaggregating the perceived prices and ability to pay a deposit, installation charges, and monthly service cost in Models 2 and 3 allows the identification of additional factors which present significant barriers to obtaining telephone service for low income households. Expectations or perceptions are an important factor in the composition of demand. Price perceptions can prevent a potential consumer from exploring a market even though actual prices may lie within a threshold purchase range. Models 2 and 3 test this hypothesis for low income households in Colorado with respect to telephone service. Results of these models are reported below.

A. Model 1, Economic Activity

In this model, income is used as the economic activity variable.[4] Income is positively related to the probability of having a phone in the household, with a 90% significance level. The relatively low significance level of our income variable compared to other studies should not be surprising considering the compression of the income differences in our low income sample.

B. Model 1, Household Composition

The presence of a member of the household over the age of 65 increases the likelihood of the household having a phone, with a t-statistic over 5.00. This is consistent with the view

that the telephone becomes a more important vehicle for communicating with others as a person ages, and also may be more important as a method to summon help in the case of accident or illness. This is consistent with previous research, for example, Perl (1978) found that the proportion of the household 65 and over as well as the age of the householder were positive and significant determinants of the probability of having a phone. It is interesting to note, however, that the presence of a household member with a physical handicap or life threatening medical problem is not significant in any of our specifications. This is consistent with recent findings of Resource Planning and Management (1988) concerning low-income Connecticut residents.

The second household composition variable concerns the marital status of the respondent, and indicates that individuals not currently married are much more likely to have a telephone. The t-statistic on this variable is significant at the 99% level. The household size positively influences the probability of having a phone, and is significant at the 95% level. This indicates that the larger the household size the greater the aggregate household utility from having a phone, thus increasing the probability of exceeding a threshold level triggering the acquisition of a phone. Perl (1978) found a negative sign on this variable in his study, and attributed this result to lower income per person in the household. Taylor and Kridel (no date) report a positive coefficient on household size in their work.

C. Model 1, Head of Household

The variables under this category concern the ethnic heritage and education of the head of the household. Households headed by an individual of Hispanic origin have a negative impact on the likelihood of having a telephone, with a 99% confidence level. This is an important factor in Colorado, since over one-third of the low income households included in the sample are headed by someone of Hispanic origin. Households with an American Indian head are also less likely to have a telephone with 95% confidence levels. On the other hand, households headed by Asians are more likely to have a telephone, with a 90% confidence level. The American Indian and Asian household head each constitute less than 2% of the households in the sample.

It is sometimes argued that the value of a phone to any individual is a function of the number of persons that individual could benefit from calling. This may partially explain the result for Hispanic and American Indian household heads, but would be at odds with the result for Asian households. These results indicate the opportunity to develop alternative approaches for local phone companies in dealing with Hispanic and American Indian households.

A household headed by an individual with less than a high school education is a negative influence on the probability of having a phone, and is significant at the 90% level. This result is consistent with Perl who found that the number of years of education of the householder is positive and

significant in influencing the probability of having a telephone. Perl (1978) argues that in the models, education may partially reflect to household's permanent (long-term) income. Therefore, the demand for telephone service is less sensitive to variations in any particular year's income than to expected long term income.

D. Model 1, Household Tenure

This category reveals important insights into the households decision concerning the acquisition of telephone service. We found that households which own the home where they reside are more likely to have telephone service. The coefficient on home ownership is significant at the 99% confidence level. Households which moved in the last 18 months are much less likely to have phone service. The importance of this result is brought into sharper focus by noting that 53.9% of the low income households in the full sample had moved in the previous 18 months, while 16.5% own their home.

The household tenure results have important policy implications. Perl included a five-year tenure variable to capture these factors in his study. Results in our study indicate low income groups move much more often than once in five years. The sheer magnitude of the low income households moving within 18 months prior to the survey indicates the need to recognize the special difficulties faced by this subset of low income individuals. The number of moves within an 18 month period, when combined with installation and deposit costs, represent a substantial barrier to having a phone. Further, it

represents a challenge to develop policies to enable this group to become a more integrated part of society through phone access.

E. Models 2 and 3, Perceived Price/Ability to Pay

One unique aspect of this study is the availability of the sample respondent's perceived price of, and ability to pay for, three elements of telephone service: deposit, installation, and monthly charge. As described previously, about one-fourth of the respondents had incomplete or inconsistent responses to these questions. Therefore, the sample size for this estimation was reduced from 629 to 466.

Perceptions play an important role in the creation of demand. This data set provides the ability to statistically test the degree to which perceptions influence demand for telephone service among low income households in Colorado. We examine the specific hypothesis that there is a greater gap between the perceived price and perceived ability to pay for households without a telephone than those with a telephone.

The summary statistics provide preliminary confirmation of this hypothesis. Those without a phone perceive the average deposit to be $80.35, while those low income individuals with a phone perceive the deposit to be $70.87. Perceived average installation costs and monthly service costs are $76.49 and $18.75, respectively, for those without a phone, compared to $71.76 and $17.31 for household having phone service. In addition, those households with telephone service indicate a minimum of five percent greater ability to pay for each of the

three costs, compared to households without a phone, which is consistent with their greater income, as discussed below. The higher perceived cost as well as the lower ability to pay for the households without a phone is further investigated using Models 2 and 3.

There are minor changes in the character of the data when moving from the full data set to the reduced version. The percent of households with an employed head, with a head of Hispanic origin, or a non-married household each changed by less than 2%. The percentage that had moved in the past 18 months increased in the reduced data set, and the percentage owning their own home decreased. Thus, the reduced data set contains more mobile households. This is also is consistent with the fact that the percentages of households with a member over 65 decreased in the reduced data set. Finally, the household size increased from 2.88 in the full data set to 3.05 in the reduced data set.

Models were estimated using all five groups of explanatory variables as described in the model section. Before reporting the results it is useful to discuss the specification of the models using the reduced data set. We attempted to include each variable that was used in the full data set. This proved successful for all except the head of household category. Only the Hispanic head of household remained significant in the reduced data set. In addition, two separate specifications of the perceived price/ability to pay category were attempted. In the first, the perceived price itself was entered directly into

the models, and in the second version a variable expressing the difference between the perceived price and the ability to pay was constructed.

The magnitude and significance of the other variables in Model 2 remained consistent with the results in Model 1. The results of Model 2 are shown in Table 2. Employment is the preferred economic activity variable and is positive and significant at the 95% level.[5] The three household composition variables: household size, not married, and presence of someone over 65 remain positive and highly significant. The only household head characteristic remaining significant in the reduced data set is Hispanic origin, which is negative and still significant at the 99% level. The household tenure variables remain important in explaining the probability of having telephone service, with recent moves and owning the home having the expected signs and 99% significance levels. The households perceived cost of the deposit for telephone service has a negative impact on its probability of having a phone, and is significantly at the 95% confidence level.[6] The goodness of fit indicates 71.7% of cases correct, 1.8 percentage points greater than the level obtained with Model 1.

Model 3 is an attempt to combine the information contained in the perceived price variables and the estimated ability to pay variables. For the three components of deposit, installation charge, and monthly service cost, a "gap" variable was constructed. For example, GAPDEP is constructed by taking

an individual's perceived size of the deposit, and subtracting the individual's ability to pay the deposit. GAPMON is similarly constructed based upon monthly service cost. The mean value of the GAPDEP is $55.47, and the mean GAPMON is $4.32, indicating that perceived costs are substantially greater than the low income individual's ability to pay.

Negative coefficients on the gap variables are expected, and this is confirmed in Table 3. Both the GAPDEP and GAPMON are negative, with the former significant at the 95% level, and the latter at 90%.[7] The coefficients of the other variables in Model 3 are very similar to Model 2. The goodness of fit measure indicates that 70.4% cases correct for Model 3, slightly less than for Model 2, but greater than Model 1 using the full data set.

The additional information contained in the perceived price/ability to pay data indicates that the deposit fee is a significant barrier to low income individuals obtaining telephone service, as is the size of the monthly service cost and deposit relative to the ability to pay. The former is consistent with our previous findings concerning the tenure of households. Other research (FCC 1989) suggests that deposits as a barrier are related to outstanding phone bills, particularly long distance bills.

SUMMARY

Telephone penetration rates are currently below average for lower income groups in the United States. The divestiture of AT&T and the pro-competitive policies of the FCC promise

increasing basic exchange rates which threaten to further erode low income telephone penetration. If progress is to be made in achieving universal service across all income groups, gains must be made for low income households.

This study specifically examines the social and economic factors influencing the demand for phone service by low-income individuals. It generally follows the methodology employed by Perl and others. The findings corroborate those of other studies. The study differs from previous research in that it concentrates on low income households and addressed several new issues. Our model shows that income, home ownership, Asian head of household, a member of the household over 65, non-married household, and a larger household size increase the probability of having a phone. Recent household moves, Hispanic and Indian heads of household, and a head of household with less than high school education decreases the probability of having a phone.

An area not addressed in previous studies is the low-income groups' perceived cost and ability to pay for monthly telephone service, deposit fees and installation charges. The size of the perceived deposit, and the difference between the ability to pay the deposit and its perceived cost is a major barrier to telephone service for low income households. The gap between the perceived monthly phone cost and the ability to pay also decreases the probability of having a phone. Another issue not adequately addressed in previous studies is the effect that number of household moves have on

the probability of low income households to have a telephone. A large percentage of households without telephone moved within the past 18 months.

Our results indicate that in order to increase low income telephone penetration, policies must be developed to address barriers caused by frequent moves of low income households, large deposit requirements, and the special needs of Hispanic households.

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FOOTNOTES

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1. Under contract with the Federal Communications Commission, the Bureau of Census includes questions on telephones as part of its current Population Survey. Data were derived from the Current Population Survey.

2. The reference group is white and black heads of households. We experimented with a dummy variable for black heads of household, but it proved insignificant.

3. The survey was drawn from the entire State of Colorado. Most participants' live in the Denver Metropolitan area, which has a single price for flat-rate local service. Price may vary for some respondents outside of the Denver area; however, the number of respondents is too small for statistically significant estimation.

FOOTNOTES (Continued)

4. In Model 1, we experimented with specifications using combinations of income and employment. Either variable alone is positive and significant at the 90% level. If both economic activity variables are used, the sign remain positive, but neither are statistically significant.

5. If income is used in place of employment in Models 2 and 3 it has a positive coefficient with t-statistics of 1.52 and 1.54 respectively. Neither the coefficient nor the significance level of other variables are sensitive to this change.

6. Model 2 was also estimated including the perceived installation charge and perceived monthly service cost. Both variables had a negative coefficient, but the statistics were -.82 and -.98 respectively.

7. Estimation of model 3 with an installation gap variable results in a negative coefficient, and a t-statistic of -.95.

Table 1

MODEL WITH FULL DATA

VARIABLE	UNIT	MEAN VALUE	COEFFICIENT	t-Statistic
Intercept			- .3358	- .78
Income	Dollars	1,324.99	.0002	1.79
DMV18	Indicator	.5391	- .5911	- 2.87
DOWN	Indicator	.1675	.7575	2.24
DHISP	Indicator	.3461	- .5832	- 2.91
DIND	Indicator	.0112	- 1.7201	- 1.86
DASIAN	Indicator	.0175	1.8175	1.63
DO65	Indicator	.2010	2.1096	5.28
DLHS	Indicator	.5295	- .3905	- 2.03
DNOMR	Indicator	.7990	.7255	2.76
HHSZ	Number	2.8868	.1594	2.33

Number of Observations 627

Cases Correct 438 (69.9%)